REMARKS

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons which follow. This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, are presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claims 22-37 are now pending in this application. Claims 22, 24-26 and 27 have been amended. Claims 28-37 have been added. Support for the amendments may be found throughout the specification, for example on page 6, line 20 to page 7, line 12, page 8, line 33, example 1 and in originally filed claims 16 and 22. Claims 28 and 29 recite the subject matter from step (A)(2) of claim 22 in the alternative. No new matter was added.

The § 112 rejections should be withdrawn

Claims 22-27 have been rejected under 35 U.S.C. § 112, ¶ 2, as being indefinite. In response, claim 22 was amended to clarify that the term "iron group metal element" is defined as "iron, cobalt and nickel" on page 8, line 33 of the specification. Applicants submit that the scope of claim 22 was not narrowed by this amendment because it substitutes the definition of the term from the specification for the term itself.

Claim 22 has also been amended to clarify that the hard film comprises one or more layers comprising at least one material selected from a carbide, a nitride and an oxide of an element selected from elements of the Groups 4, 5 and 6 of the Periodic Table, aluminum and silicon and a mutual solid solution thereof. This definition of the hard film includes carbonitrides, such as TiCN, described in Example 1 of the present application.

Applicants submit that the term "hard phase" is defined in claim 22 and satisfies § 112, ¶ 2. The term "hard phase" in claim 22 is a phase which contains tungsten carbide. Thus, this term complies with § 112, ¶ 2, because one of ordinary skill in the art could ascertain the scope of this term. Applicants respectfully request a withdrawal of the rejection.

The § 103(a) rejections should be withdrawn

Claims 22-27 have been rejected under § 103(a) as being obvious over Okamura (USP 5,660,881) or Battaglia et al. (USP 5,709,907). These rejections are respectfully traversed because Okamura and Battaglia et al. do not teach or suggest electro-chemical polishing of the substrate, as recited in claim 22.

Page 5 of the Office Action states that:

> One skilled in the art would reasonably expect that any polishing technique would produce cutting tools with those benefits. It would have been obvious to one skilled in the art to incorporate an electro-chemical polishing treatment with the expectation of obtaining the same results.

Applicants respectfully disagree. First, the prior art has to provide some motivation to substitute the surface treatment techniques of Okamura and Battaglia et al. with electro-chemical polishing. In this case, the Office Action did not rely on any prior art reference which provides motivation to substitute the surface treatment techniques of Okamura and Battaglia et al. with electro-chemical polishing or which teaches that any polishing technique would produce cutting tools with the same benefits as electro-chemical polishing.

Second, the present inventors unexpectedly determined that electro-chemical polishing produces cutting tools with unexpectedly better hard film adhesion than other surface treatment methods. Thus, electro-chemical polishing treatment does not lead to the same results as other surface treatment methods.

As illustrated in Tables 1, 2 and 3 on pages 19, 21 and 23 of the present specification, the present inventors compared cutting tools in which the substrate was subjected to electro-chemical polishing (i.e., electropolishing) in Samples 1-10 and in which the substrate was subjected to other surface treatments (lap treatment in Comparative Sample 3 and wet blast treatment in Comparative Sample 4). As shown in Table 2, the cutting tools of Samples 1-10 had no cracks and fine particles in locations specified in Table 2. In contrast, the cutting tools of Comparative Samples 3 and 4 contained cracks and fine particles. Furthermore, as shown

in Table 3, the cutting tools of Samples 1-10 generally had less defects and peeling than the cutting tools of Comparative Samples 3 and 4.

Therefore, the electro-chemical polishing treatment unexpectedly does not lead to the same results as other surface treatment methods. Applicants respectfully request a withdrawal of the §103(a) rejections because there is no motivation to modify the prior art references as suggested in the Office Action and because of the unexpected results achieved by the claimed method.

Okamura

Okamura discloses a method of manufacturing CVD diamond coated cutting tools which comprises coating a cutting tool member with diamond by chemical vapor deposition, as pointed out on page 4 of the Office Action. The diamond film of Okamura is different from the hard film recited in claim 22.

In this reference, a sintered WC-based cemented carbide substrate is subjected to chemical etching in an aqueous solution containing an acid (5% nitric acid as disclosed at column 4, lines 6-7 of the reference) so that Co in the substrate is removed by the chemical etching step to the depth of from 3 to 15 μm, as disclosed at column 3, lines 18-21 of the reference. Thus, an amount of Co at the surface of the substrate is markedly reduced as compared to an amount of Co at inside thereof, as clearly shown in Fig. 1 thereof. This is because the high concentration of Co at the interface between the diamond coating and the WC based cemented carbide substrate is responsible for poor adhesion of the diamond coating, as mentioned at column 1, lines 49-52 of the reference. The protrusions on the substrate surface are then polished by ultrasonic polishing.

In contrast, in the claimed method, a surface treatment of a substrate is carried out by machining and electro-chemical polishing treatment. For example, an electro-chemical polishing treatment in a salt solution showing an alkaline property predominantly removes a hard phase particle (WC) such that an amount of Co at the surface of the substrate is not decreased. If present, Co is retained at the substrate surface after the electro-chemical polishing treatment. Furthermore, as recited in claims 29 and 31, Co is actually enriched at

the substrate surface by coating a Co film on the substrate to enhance the adhesion of the hard film to the substrate.

Thus, one of ordinary skill in the art would not have been be motivated to substitute the etching and ultrasonic polishing steps of Okamura, which remove Co from the substrate surface for improved diamond film adhesion to the substrate surface, with the machining and electro-chemical polishing step of claim 22, because they do not necessarily remove the Co from the substrate surface, as required by Okamura.

Battaglia et al.

Battaglia et al. disclose a method of producing a cutting tool by depositing a single or a multiple layer coating onto a substrate of tungsten carbide which has binders and other materials, as pointed out on page 4 of the Office Action. Battaglia et al. teach to resinter the substrate after grinding to adjust the surface roughness (which is coarser than usual). In this method, adhesion of the substrate to a deposited hard film is improved by removing a deformed layer and forming unevenness on the surface of the substrate. Battaglia et al. disclose grinding, polishing, buffing or laser glazing the substrate. These methods generally are mechanical surface treatment methods. Thus, the deformed layer is generally not completely removed by such mechanical methods.

In contrast, in the presently claimed method, a deformed layer (including a burnt surface) is removed by electro-chemical polishing. The deformed layer is preferably completely removed by the electro-chemical polishing. After the polishing, the surface of the substrate is made smooth and uniform, and the deformed layer is completely removed. Thus, the adhesion between the substrate and the hard film is markedly improved compared to mechanical surface treatments, as mentioned at the paragraph bridging pages 6 and 7 of the present specification and as illustrated in Example 1.

Conclusion

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The

Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date 6/18/03

By _____

FOLEY & LARDNER
Customer Number: 22428

22428
PATENT TRADEMARK OFFICE
Telephone: (202) 672-5300
Facsimile: (202) 672-5399

Leon Radomsky
Attorney for Applicant
Registration No. 43,445

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.